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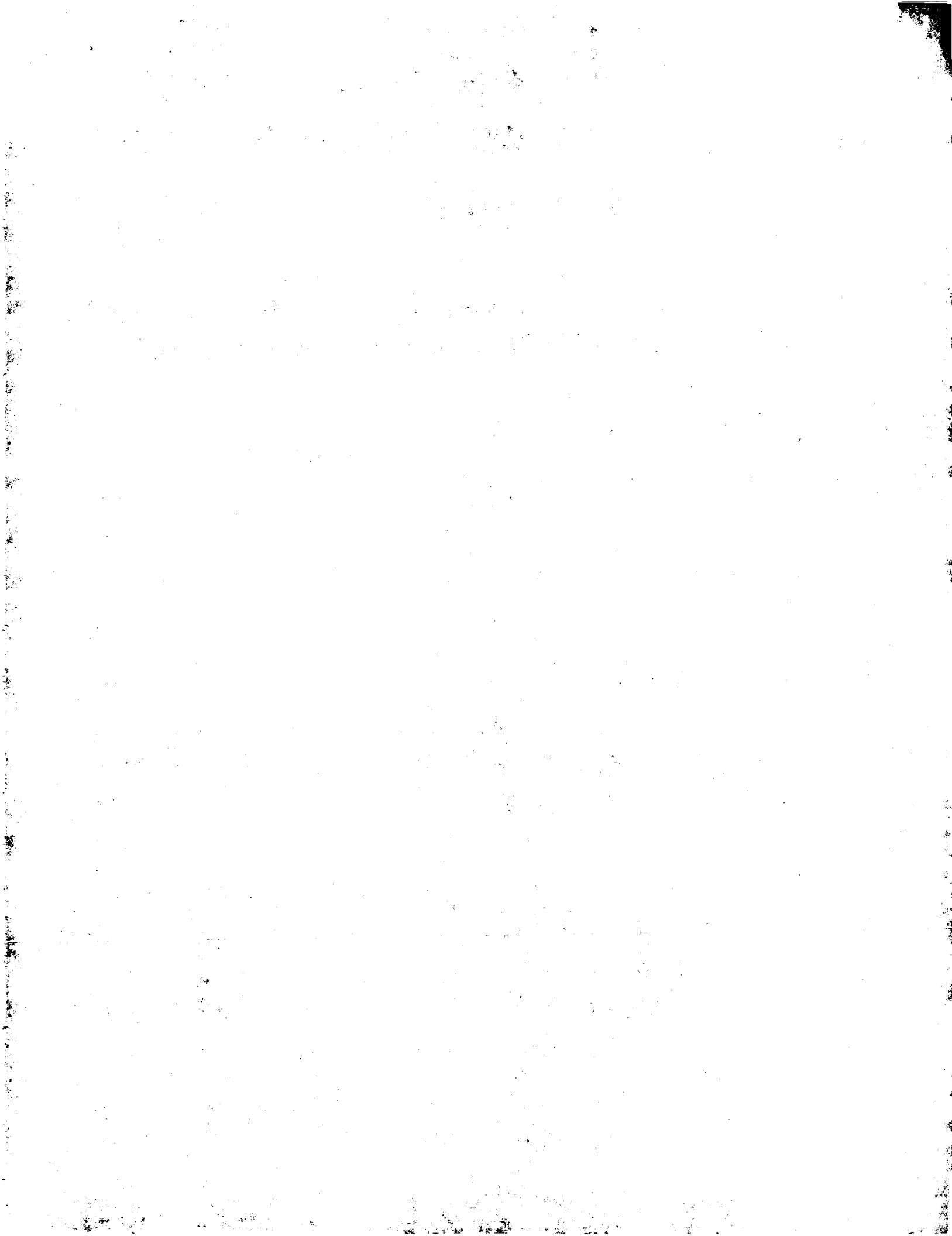
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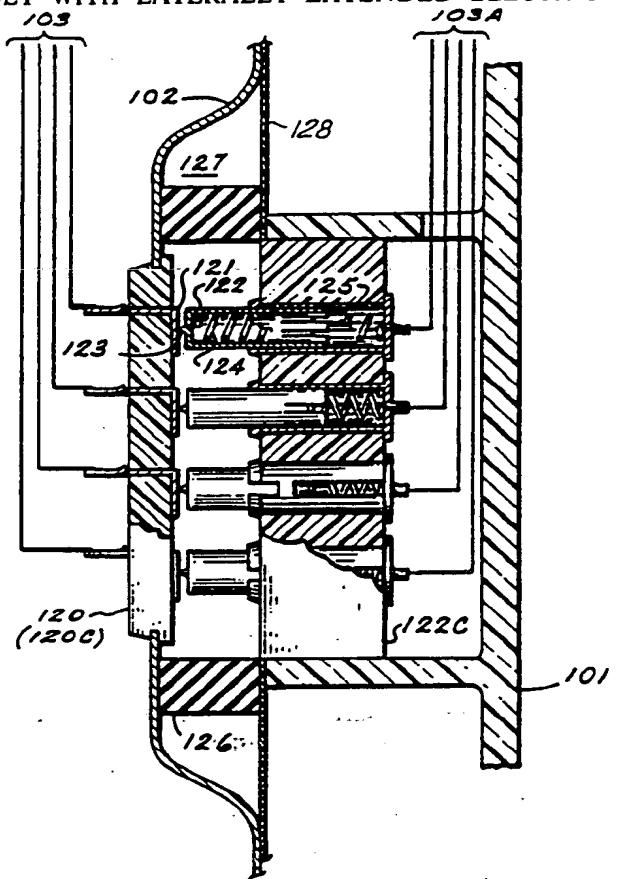
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(54) Title: VEHICULAR MODULAR DOOR PANEL ASSEMBLY WITH LATERALLY EXTENDED ELECTRICAL CONTACT INTERFACING 103 103A

(57) Abstract

The invention pertains to a vehicular door assembly and electrical interfacing system for a vehicular door frame movably attached to a vehicle body, and a method for assembling the vehicular door assembly and electrical interfacing system to the vehicular door frame. Known methods suffer from the drawbacks of being time consuming and requiring precise positioning of components. The above problems are solved by providing a door frame (102) with a contact pad (120), and providing a door panel module (101) with contact members (122) that are biased by springs (124). The contact members (122) are brought into an interfacing relationship with pad (120), thereby making electrical connections.



100-107

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AND
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BRIEF EXPLANATION

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Description

**Vehicular Modular Door Panel Assembly
With Laterally Extended Electrical Contact Interfacing**

Cross Reference to Related Applications

5 This application is related to the subject matters disclosed and claimed in U.S. patent applications Serial No. 07/097,555, filed September 15, 1987, entitled "Modular Trim Panel Unit For Motor Vehicle Doors" by Rochford R. Basson, David V. Tinder and George A. Wooldridge, as well 10 as Serial No. 07/097,230, filed September 15, 1987, entitled "Modular Panel Assembly, Particularly Automotive Door Panels, with Independent Coupling of Modular Components" by Daniel E. Boileau, issued as Patent No. 4,766,697 on August 30, 1988, and Serial No. 07/177,728, 15 filed on March 28, 1988, entitled "Guidance Receptor Cup System For Automotive Modular Panels" by R. Bozyk and J. Quan, all assigned to the assignee hereof, the disclosures of which related applications are incorporated herein by reference.

20 **Technical Field**

The present invention relates to automotive modular door panel assembly systems in which a modular door panel, such as for example, an interior trim panel module, which carries on it a number of the electrical components for the 25 door, such as for example one or more switches, window regulator drive(s), power door lock components, electrical wiring, etc., is separately manufactured off-line and thereafter attached to the main door frame of a vehicle in the main assembly line process. The present invention is 30 more particularly directed to the electrical interfacing and electrical interconnection of the electrical elements between the door panel module and the main door frame in the assembly line attaching process. Even more particularly, the present invention relates to the automatic 35 electrical interfacing between the electrical components or

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wiring on the modular door panel and those still mounted directly on the door's main frame in the final door assembly.

Background Art

Heretofore, it has been the general practice to completely assemble all of an automobile's door components on line in the main assembly line of the automotive manufacturer. In such an operation most, if not all, of the mechanical and electrical components for the door are assembled directly on the door framing members in the main assembly line, a tedious and time consuming process tending to significantly slow down the assembly line operation.

In particular, after the electrically powered mechanical elements or components were attached to the door frame, the electrical wiring was strung and attached to the various elements. When it came time to attach the final trim panel, wiring for the switches, which ultimately were mounted on the outside of the trim panel, had to be attached to the switches through openings in the panel, mating male leads with female contacts, requiring relatively precise lateral alignment. This prior art process is generally illustrated in Figures 1 & 1A.

There has been a recent move to accomplish a substantial amount of the door assembly off-line, typically at a remote, subcontractor's facility. In this subassembly, the subcontractor might, for example, provide a modular interior door trim panel, upon which are mounted a significant number of the mechanical and electrical components for the door. Note, for example, co-pending U.S. Patent Application Serial Number 07/097,555, filed September 15, 1987, entitled "Modular Trim Panel Unit for Motor Vehicle Doors" of R. Basson et al. Various ways of automatically interfacing mechanical component elements in the assembly and attachment of the door panel module and the door frame

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are disclosed in said applications of Boileau and Bozyk & Quan.

In such final, on-line assembly operations, it is necessary to ultimately interconnect the electrical wiring

5 between the various components that have been pre-assembled as part of the modular door panel and the various electrical wiring and electrically powered components or mechanical elements that are still assembled directly onto the main door frame in, for example, the main assembly line.

10 Because, *inter alia*, of the difficulty in trying to interface the various electrical components and wiring between the modular door panel and the door frame, it has been the predominant practice in the automotive industry to include most of the wiring on the main door frame and/or to 15 use male/female connectors to interconnect the electrical components across the interface between the modular door panel and the main door frame, with such interconnection being done manually as a separate, at least generally independent sub-step. Thus, the workers on the assembly

20 line would, in essence, have to delay the attachment of the modular door panel to the main door frame until they had 25 separately and manually interconnected the various male/- female connectors between the two, or alternatively, after or while the panel and the main frame were being attached together, subsequently manually interconnecting the various male/female connectors.

Such an approach requires additional time and handling, with a concomitant added burden on the assembly line workers. Additionally, such handling requires 30 relatively precise relative positioning of the male/female connector components to insure an accurate interconnection of the electrical components. This has made it more difficult to automate this phase of the door assembly operation, and, for example, has not allowed the full use 35 of robotic technology.

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In contrast, the present invention provides for the automatic interfacing of the electrical components, regardless of the number involved and without requiring precise relative positioning of the panel module with respect to the door frame to insure a good electrical interconnecting interface in the final assembly and attachment of the modular panel to the door frame, all without the need for any manually actuated electrical connections.

10 **Disclosure of Invention**

The present invention thus provides for the automatic interfacing of electrical components between at least one electrical component provided on the modular door panel and another electrical component mounted on the main door frame, particularly during the interfacing and assembly operation of the modular door panel to the main door frame in the main assembly line operation.

To achieve this in the preferred, exemplary embodiment of the present invention, one or more series of juxtaposed, spring-biased contacts are used to resiliently engage laterally extended, stationary contacts on the other door element or section. The laterally extended contacts have relatively large, laterally extended, facial areas (in comparison to the diameter of the male/female members used in the interconnection approach of the prior art). Such allows the door panel module to be only generally located in lateral alignment with respect to the main door frame, as the two are brought together and connected together.

The approach of the present invention allows a substantial amount, if not the vast majority and indeed if not all, of the wiring for the automotive door to be provided on the modular door panel in the off-line, sub-assembly panel module manufacturing operation, further adding to the savings in labor and assembly line time on the main assembly line.

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Hence, the assembly of the wiring or wiring harness is transferred from the assembly plant to the trim supplier, providing for a more controlled assembly environment.

Thus, preferably, the great bulk of the wiring needed to interconnect the switches, any remote multiplexing (remux) unit, as well as any power drives for the window

and for the door locks, to the main wiring harness can all be placed and be pre-wired in the remote, off-site, sub-

assembly operation. This minimizes the amount of electrical work that needs to be done with respect to the main door frame and allows the final electrical connections and

interfacing between the panel and the door to be achieved merely by generally guiding the door panel into interfacing contact with the main door frame, the electrical intercon-

nections being achieved in a totally automatic operation with the need for any manually made up electrically

connectors.

Additionally, the switches are preassembled to the trim panel module and are already connected to the primary

laterally extending wiring going from lateral end to lateral end of the door panel module or even to the wiring harness itself if included as part of the panel module.

Therefore, it is not necessary for the operator to thread a wiring connector through the water shield and door trim panel hole during switch assembly, as was necessary in the prior art approach.

Line balancing is therefore easier, and the main assembly line operator has the same number of operations to carry out, regardless of whether power windows, power door

locks, or a combination of both, are fitted.

Some of the other advantages of the present invention are that it allows the panel assembly to be robotically assembled with the main door frame, if desired, and there is no requirement that the two members be precisely

laterally aligned together to make the electrical interconnections between the electrical components and wiring on

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the modular panel and the electrical components and any wiring on the main door frame.

Additionally, the trim panel module can be pre-tested for electrical integrity prior to shipment to the assembly plant.

The foregoing and other features and advantages of the present invention will become more apparent from the following description and drawings.

Brief Description of Drawings

Figure 1 is an exploded view, showing the general pre-attachment positioning of the door trim panel with respect to the main door frame in the assembly line operation, with the prior art approach of the electrical interfacing connections being positioned for manual interconnection with all of the wiring of the door being placed in door frame and none on the trim panel; while

Figure 1A is a partial, detail, side view, showing the relative precise positioning required for mating the male leads with the female contacts in the prior art approach of Figure 1.

Figure 2 is an exploded view, similar in perspective to Figure 1, but showing the general positioning in the present invention of the door trim panel module with respect to the main door frame in the assembly line operation, with the electrical interfacing connections being positioned in general opposition for automatic interconnection.

Figure 3 is a side, partial, cross-sectional, detail view of the fully assembled panel module and door frame, taken in the combined area of the two sets of cross-section lines 3-3 of Figure 2, showing in detail, the resilient interfacing between the electrical, spring loaded contacts on the door panel module and the stationary, flat-faced contacts on the main door frame, representing the exemplary, preferred embodiment of the present invention.

Figure 4 is an exploded, perspective view of the electrical interconnection elements of Figure 3.

Best Mode for Carrying Out the Invention

As can be seen in the prior art approach of Figure 1, in the main assembly line operation the wiring harness 3, which extends from end-to-end of the door frame 2, is mounted directly on the door frame, along with all of the supplemental wiring and the mechanical and electrical components, except for the switches 4 & 5; while none of the electrical or mechanical components except for the switches are included on the simple trim panel 1. This prior art approach requires that, before the trim panel 1 can be mounted on and attached to the door frame 2, the loose wiring connectors 6 & 7 for the power window motor 8 and the power door lock 9, respectively, must be connected, typically through a male/female connector set (note Fig. 1A) requiring relatively precise lateral alignment, to the back sides of the switches 4 & 5, respectively, using the trim panel openings 10 & 11.

In contrast, as can be seen in the simplified illustration of Figure 2 of the exemplary, preferred embodiment of the present invention, an interior trim panel module (such as, for example, one similar to those that are disclosed in assignee's co-pending U.S. Patent Application Serial No. 07/097,555, the disclosure of which is incorporated herein by reference) is positioned generally in front of and is ultimately interfaced and mated with the main automobile door frame 102 in the assembly line operation. The trim panel module 101 preferably, for example, includes at least most of the electrical components (if not also most of the mechanical components) used within the complete automotive door, with only a relatively few components being directly assembled on-line within the door frame 102.

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Thus, for example, some of the few electro-mechanical components left for direct, on-line assembly to the door frame 102 might be, as illustrated, the drive motor 108 for the window regulator located toward the center of the door frame 102 and the final powered lock component 109 located at the back end 102B of the door frame. The main wiring harness 103 can be included with the modular trim panel 101, as shown in the Basson et al application, or associated with the main door frame 102, as illustrated in Figure 10 2. As is well known, the wiring harness 103 includes one or more connectors (note connectors 3B in Figs. 1 & 2) at its distal end for connecting the electrical door components into the main electrical system in the main body of the vehicle being made.

15 In accordance with the invention, at least one electrical contact pad 120 is provided adjacent to the electrical component(s) directly assembled on the door frame 102. As illustrated in Figure 2, this can include, for example, relatively flat, stationary, laterally 20 extended pads 120A & 120B for the electrically powered window and lock components 108 & 109, respectively, with the former being somewhat centrally located on the door frame section 102 and the latter being located at the back end 102B of the frame section.

25 If the wiring harness 103 is to be directly associated with the door frame 102, rather than being made up and affixed to the trim panel module 101 during its manufacture, an additional contact pad 120C is provided at the front end 102A of the door frame 102. Also, other contact pads 120 could be provided for any other component(s) directly mounted on the door frame 102, including for further example a scurb or other door light, any motor drives and heaters for the side, rear view mirror on the side of the driver's door, or for a motor drive for a vent window, etc. 30 35 Although only a single, fixed pad 120 could be made to work for multiple, significantly spaced, electrical com-

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upon nts on the door frame 102 by including wiring strung from such a single pad 120 to the various electrical components, preferably separate, juxtaposed pads 120A+, one for each component which is significantly spaced from the other(s), are used, as illustrated. Thus, minimal wiring, if any, is included directly on the door frame 102.

Indeed, by integrating the flat pad 120 into its respective electrical component, all wiring directly for the components on the door frame 102 can be eliminated. In fact, by including even the harness wiring on the trim panel, by using, for example, relatively flat planar cable for the wiring across the hinge gap, all of the wiring can be eliminated from the door frame 102. For detailed information on the "planar cable" approach, reference is had to the concurrently filed, co-pending U.S. application Serial No. 07/191,087 of J. Wright, entitled "Electrical Planar Cable Interconnection Between Automotive Door and Body," the disclosure of which is incorporated herein by reference.

However, at the very least, using at least the approach illustrated of using contact pads 120A & 120B adjacent to the components 108 & 109, the extensive, lateral wiring 3A, i.e., the wiring extending from end-to-end 2A-2B of the door frame 2 of the prior art, as illustrated in Figure 1, is eliminated.

Instead, all such wiring (note, e.g., phantom-lined, laterally extended wiring 103A) is preferably included on the modular door panel 101, along with, for example, the switches 104 & 105, which are connected to the wiring harness, like the rest of the wiring through the front end contact pad 120C, if the wiring harness 103 is not carried directly by the panel module 101. Such an approach, which has most if not all of the wiring on the panel module 101, greatly lends itself to robotic and other automatic manufacturing techniques with respect to the electrical wiring for the door.

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As can best be seen in Figures 3 & 4, each of the electrical interfacing contact pads 120 includes a number of static contacts 121, each having, for example, an "L" shaped configuration in its side cross-section and having a significant lateral extension for its interfacing area of, for example, about an half an inch on each side or more. This is in contrast to the male terminals of the connectors of the prior art having a diameter of only about a sixteenth of an inch, which are inserted into female holes of a like, relatively small diameter (note Fig. 1A). A sufficient number of static, "L" shaped contacts 121 are included to provide the required lead wires or connections to the electrical component(s) involved, which typically will require a minimum of two contacts or wires.

Additionally, a like number of longitudinally or orthogonally moveable, spring biased contact members 122 are included on the door trim panel 101, which moveable contacts likewise can have a relatively large, laterally extended face or a centrally located contacting dimple or protrusion 123, as illustrated. Internal springs 124 resiliently bias the contacts 122 out away from the door trim panel 101 but allow them to be pushed back into their respective seats 125, as the door trim panel 101 and the door frame 102 are brought compressively together and mechanically attached. Appropriate stop means are provided between the orthogonally movable contact members 122 and their seats 125 to prevent them from coming out their seats in their normal operation.

A rubber sealing gasket 126 surrounding the electrical contact interfacing between the pad 120 and the movable contact members 122 is provided, preferably on the door frame 102, with the pad being included in a depressed area 127 on the door frame, as illustrated in Figure 3. Additionally, a plastic vapor or moisture or water shield layer 35 128 could be included on the modular trim panel 101, as

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illustrated. All of this results in a relatively water-free, electrical interfacing area.

In the final door panel assembly operation, the trim panel module 101 is typically positioned in parallel, frontal array to the door frame 102 and then either moved in towards the door frame 102 in direct fashion, maintaining an at least general parallel alignment between the two, or, alternatively, the top of the trim panel module 101 is initially engaged with a top portion of the door frame 102 and pivoted down in the interfacing, juxtaposition and attachment steps. In either case, a series of, for example, spaced snap fastening pins 112 lockingly interface with like located openings 113 on the door frame 102.

As the panel module 101 and the door frame 102 are brought together the orthogonally movable electrical contacts 122 automatically interface and make the circuit between it and the static contacts 121. Because of the relatively large lateral extent and flatness of the contacts 121, which allow relative side movement while still maintaining electrical contact, precise positioning and alignment of the panel module 101 and the frame 102 is not necessary to insure good electrical interfacing.

Again, all of the electrical interfacing connection is achieved without any manual making-up of electrical connectors, which require for example two or more relatively small male terminals to be inserted into like relatively small female openings (note Fig. 1A), requiring precise relative lateral positioning between the connector elements.

Likewise, after the vehicle has been completely manufactured and has left the plant, should any internal door maintenance be necessary, the panel module 101 is merely disconnected and pulled orthogonally away from the door frame 102, and, insofar as at least the electrical interfacing connections 121/122 are concerned, no manually actuated disconnection of electrical connectors is neces-

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sary. The resiliently biased contact members 122 merely extend further out under the action of the springs 124 from the panel module 101, ready to resiliently re-make the electrical interfacing connection when the panel module and the door frame are rejoined.

Although the preferred exemplary embodiment has been illustrated with the movable contact members 122 located on the panel module 101 and the stationary, laterally extended contacts 121 located on the door frame 102, these relative components could be switched, that is the movable contacts 122 could be located on the door frame side, with the static pad 120 located on the panel module 101.

These are, of course, merely exemplary modifications and not at all exhaustive of the many variations which can be made in the preferred, exemplary embodiment disclosed in detail above.

Although this invention has been shown and described with respect to a detailed, exemplary embodiment thereof, it should be understood by those skilled in the art that various changes in form, detail, methodology and/or approach may be made without departing from the spirit and scope of this invention.

Having thus described at least one exemplary embodiment of the invention, that which is new and desired to be secured by Letters Patent is claimed below.

1. A door assembly for a vehicle, comprising:
a. a door frame having a door panel module and a door panel;
b. a panel module having a panel member, a panel pad, and a panel contact member, the panel member being resiliently biased to extend laterally from the panel module, the panel pad being positioned to receive the panel member when the panel member is extended laterally, the panel contact member being positioned to interface with the panel pad when the panel member is extended laterally;
c. a door panel having a door frame contact member, the door frame contact member being positioned to interface with the panel contact member when the panel member is extended laterally; and
d. a door handle assembly having a handle, a handle frame, and a handle contact member, the handle being attached to the door frame, the handle frame being attached to the door panel, the handle contact member being positioned to interface with the door frame contact member when the handle is in an open position.

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Claims

1. A vehicular door interfacing method allowing for ease in assembly and disassembly of the door, in which a door panel module section is initially attached to a door frame section in an assembly line operation to make a final door structure and in which electrical component parts for the door are included and need to be electrically interconnected, one component part being located on the door panel module section and an electrically associated component part being located on the door frame section, the door frame section having a front end and a back end, with the front end being hingedly connected to a vehicle body, comprising the following steps:

15 a) at least generally aligning the vehicular door panel module section with the vehicular door frame section and moving the two longitudinally toward each other on the assembly line into at least general interfacing juxtaposition without any assurances that the door panel module section and the door frame section are precisely laterally aligned and without the door panel module section and the 20 door frame section being electrically connected together; and

25 b) utilizing a resiliently mounted electrical contact on one door section and a laterally extended contact plate on the other door section to automatically electrically interconnect at least said two component parts together as the door sections are brought together in contact; and

30 c) moving said door sections toward each other in the longitudinal direction, using said laterally extended contact plate to make contact with said resiliently mounted contact member, even when the two door sections are not precisely laterally aligned and are laterally movable with respect to one another, the two electrical contacts being automatically interfaced and electrically connected 35 together, and using the resiliency of said contact member

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to maintain electrical interconnection, as and after the door assembly operation has been completed.

2. The method of **Claim 1**, wherein said resiliently mounted contact is orthogonally, movable with respect to the door section it is mounted on; and wherein, in steps "b" & "c", there is included the steps of:

5 placing said resiliently mounted contact in general contact with said contact plate and moving said resiliently mounted contact in the orthogonal direction as the door sections are pushed and connected together.

3. The method of **Claim 2**, wherein the final door structure has an electrical component located in an area substantially spaced from the front end of the door structure and the electrical component is electrically connected to the vehicle body by means of a main wiring harness going from the final door structure to the vehicle body, and wherein there is included the further, preliminary step of:

10 affixing electrical wiring, that will ultimately connect any electrical components located at the back lateral end and central areas of the door to the main wiring harness going to the vehicle body, to the door panel module section as part of a sub-assembly operation for manufacturing the door module panel section at a site

15 remote to and at a time prior to the final door structure being made in the main assembly line, with no wiring laterally extended from end-to-end being included in said door frame section prior to the mounting and attachment of said door panel module section to said door frame section.

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4. The method of Claim 3, wherein there is included the further, preliminary step of:

attaching a laterally extended pad having at least two laterally extended contacts to each operative electrical component which is to be mounted directly on said door frame section on the main assembly line for electrically interfacing with a like positioned, resiliently mounted contact members on said panel module section.

5. The method of claim 3, wherein the vehicle door to be made is to have an electrically powered window and an electrically powered door lock, and wherein there is included the further, preliminary step, performed before the panel module section is attached to the door frame section, of:

attaching directly to said door frame section an electrical door lock component at the back end of the door frame section and a window drive motor located centrally in said door frame section and a separate, laterally extended pad in juxtaposition to said door lock element and said window drive motor, with each contact pad having at least two laterally extended contacts electrically connected to its respective operative electrical component, on the main assembly line, for ultimate electrically interfacing with like positioned, resiliently mounted contact members on said panel module section.

6. The method of Claim 1, wherein, after all of the assembly steps of steps "a" through "c" have been performed and the vehicle has been completely made and has left the vehicle manufacturing plant, there is included the disassembly steps of:

removing the door panel module section from the door frame section, the electrically interfacing components being electrically disconnected and disengaged merely by pulling the panel module section longitudinally away from

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10 the door frame section with the resiliently mounted contact merely moving resiliently away from the contact plate, without the need of manually un-making any electrical connectors.

7. A vehicular door assembly, electrical interfacing system for a vehicular door frame movably attached to a vehicle body, comprising:

5 automotive door panel module means for attachment to the door frame in a vehicle assembly line operation; and

10 an electrical component interfacing system between the door frame and the door panel module means, including

- a laterally extended pad having at least two laterally extended contacts electrically connected to each operative electrical component which is to be mounted directly on said door frame on the main assembly line, and

15 - a series of resiliently mounted, movable contact members mounted on said panel module means, said contact members being positioned in a like array to that of said laterally extended contacts, said resiliently mounted contact members being electrically interconnected to said contacts in a face-to-face resilient engagement.

8. The vehicular door electrical interfacing system of Claim 7, wherein said movable contact members include springs resiliently biasing them out from said panel module means.

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9. The vehicular door electrical interfacing system of Claim 7; wherein said panel module means includes at least two, separate, spaced series of said resiliently mounted contact members, one series located at the back 5 lateral end of said panel means and the other series located in a central area of said panel module means; and wherein there is further included:

- laterally extended wiring affixed to said panel module means extending from end-to-end of said panel 10 module means.

10. The vehicular door electrical interfacing system of Claim 9, wherein there is further included:

- a wiring harness affixed to said door panel module means and carried thereby independently of whether 5 said panel module means is connected to said door frame means, said wiring harness integrally including said wiring.

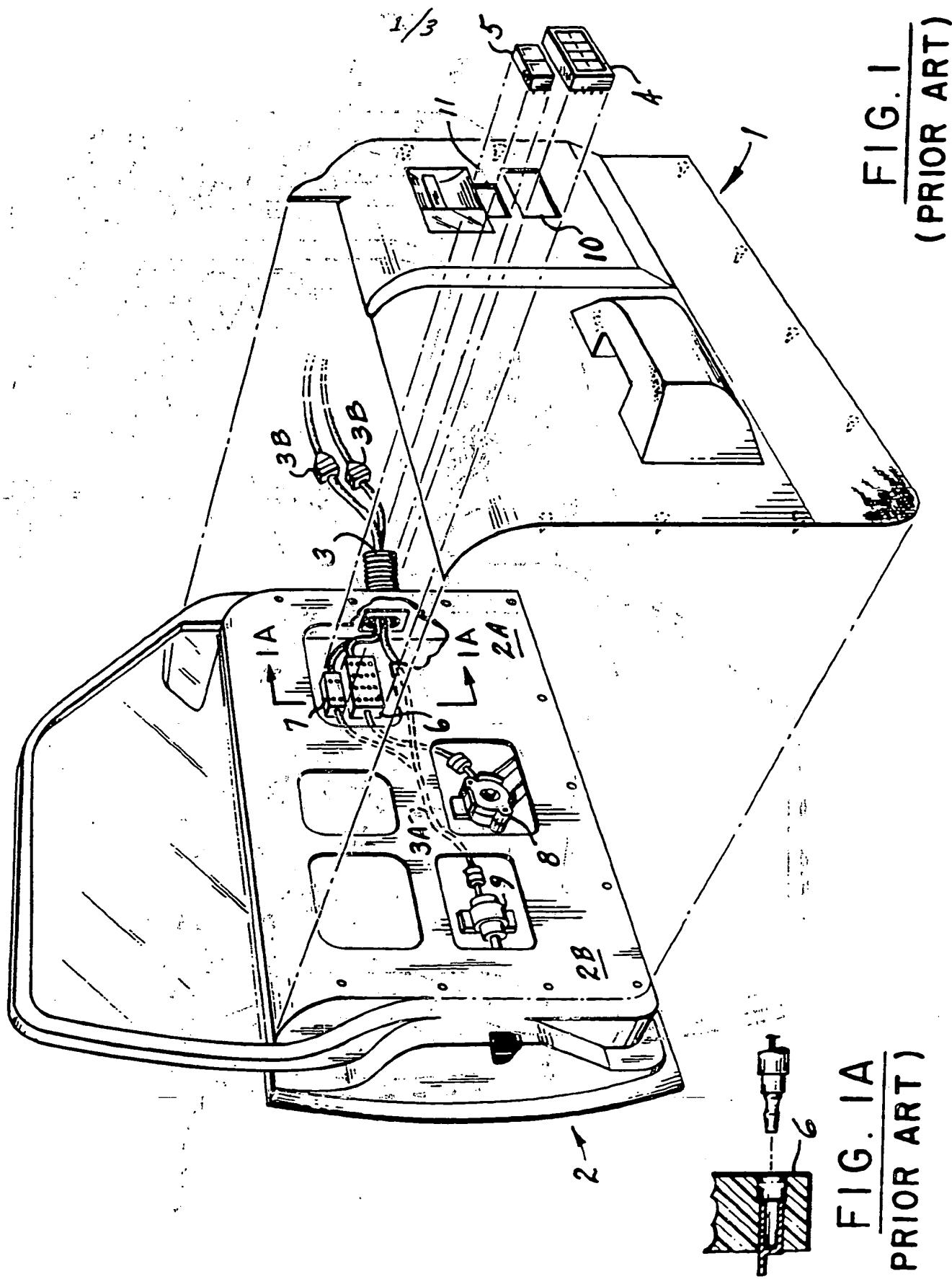
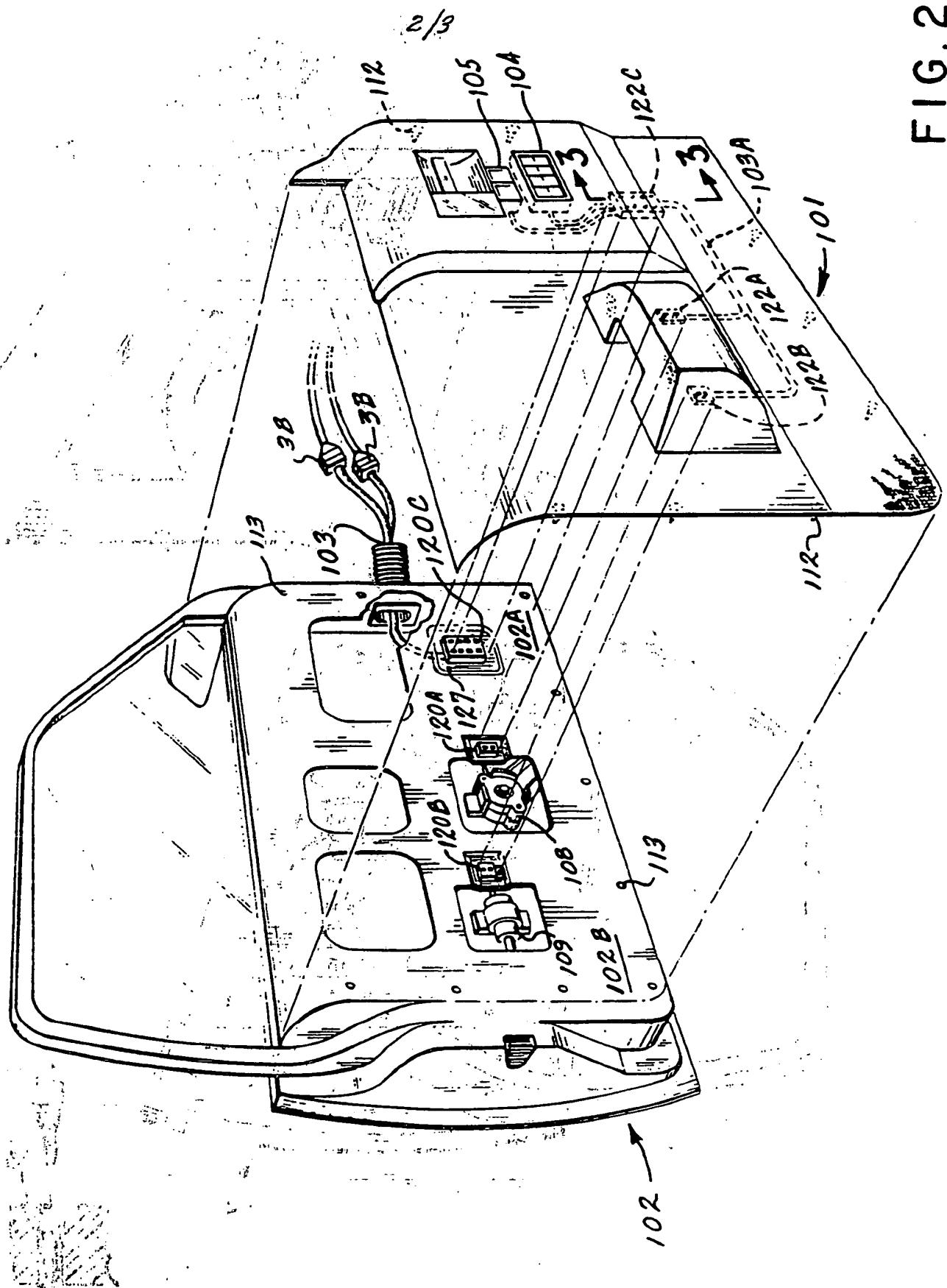


FIG. 2



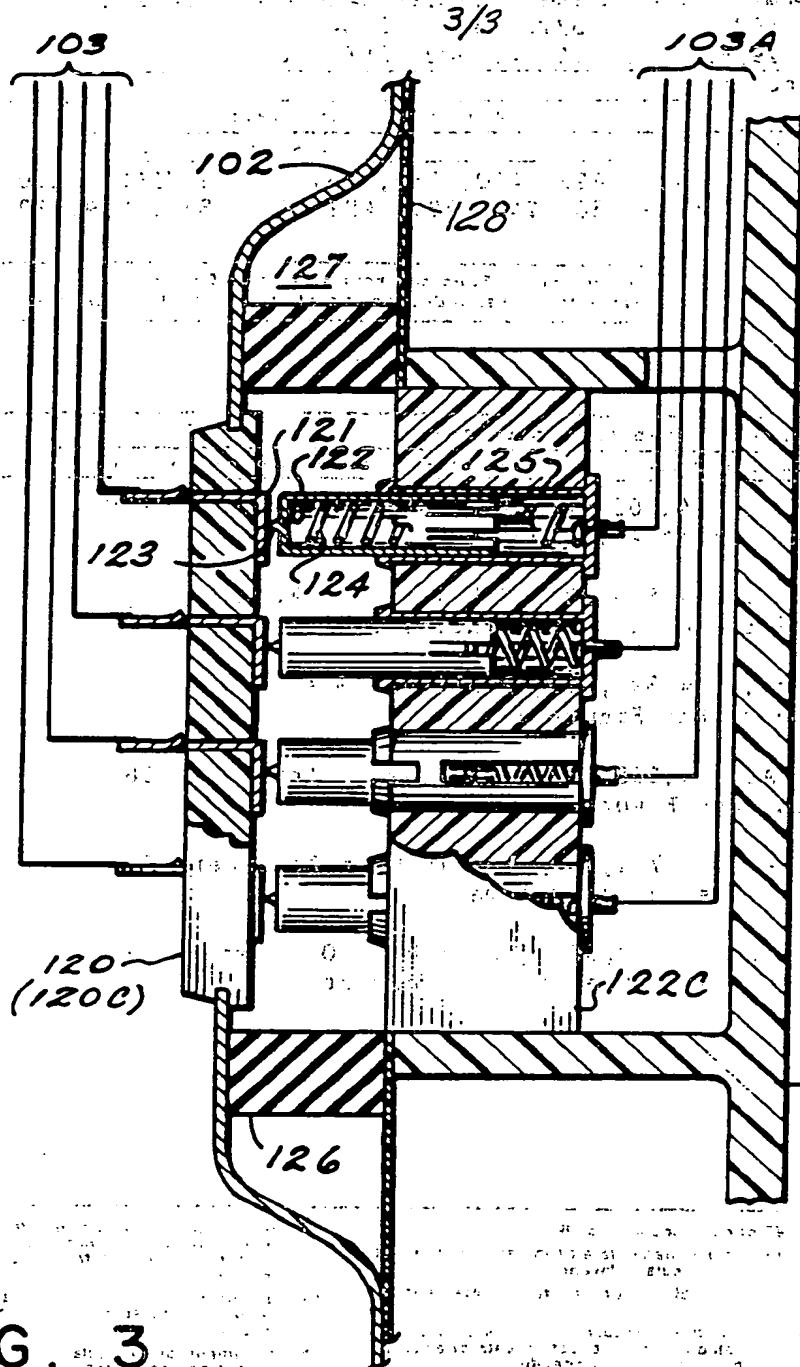


FIG. 3

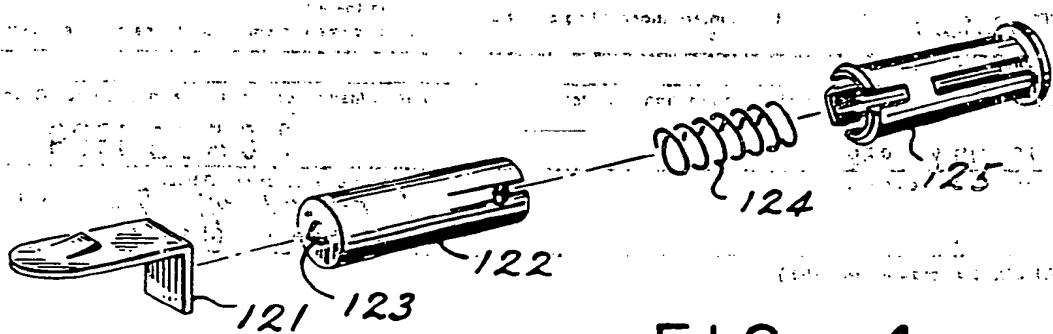


FIG. 4

INTERNATIONAL SEARCH REPORT

International Application No. PCT/US89/01926

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)

According to International Patent Classification (IPC) or, if both National Classification and IPC

INT. Cl. (4) HO1R 43/26 B60J 5/04

U.S. Cl. 29/429 29/854 49/502 296/146

II. FIELDS SEARCHED

Minimum Documentation Searched *

Classification System	Classification Symbols
U.S.	29/428, 429, 430, 469, 854 49/502 296/146 439/29, 30, 244, 289, 482, 816, 817, 819, 824

Documentation Searched other than Minimum Documentation,
to the Extent that such Documents are Included in the Fields Searched *

III. DOCUMENTS CONSIDERED TO BE RELEVANT *

Category *	Citation of Document, * with indication, where appropriate, of the relevant passages *	Relevant to Claim No. *
Y, P	US, A, 4,800,648, Published 31 January 1989, Nakayama et al. See entire document	1-10
Y, P	US, A, 4,815,984, Published 28 March 1989, Sugiyama et al. See entire document	1-10
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IV. CERTIFICATION

Date of the Actual Completion of the International Search

Date of Mailing of this International Search Report

12 JULY 1989

16 AUG 1989

International Searching Authority

Signature of Authorized Officer

ISA/US

Joseph M. Gorski
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